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Energy-rich feed flakes for fish and invertebrates, as well
as process for the production

Description

Usually, at present, fish feeds, especially for ornamental fish, are characterised by a relatively high protein content (about 40 - 50%) and amount of starch (about 16 - 30%) in the case of simultaneously relatively small energy content (about 0.5 - 8% fat). Such feeds can be produced industrially without problem in forms of application usual for the maintenance of fish (feed flakes, floatable extrudates, tablets) and lead to a good growth and to a sufficient nutrition of the animals.

On the other hand, for the breeding and feeding of useful fish, energy-rich feed in the form of extrudates or pellets are increasingly used which, besides a high protein content important for the growth, have fat contents of up to 25% (BioMar GmbH, company brochure "Fütterung/Umwelt - Ecoline"). The use of such feeds in the professional fish breeding leads, in comparison with fat-poorer products, to less water-contaminating, nitrogen-containing excretion products (ammonia, nitrite, nitrate) since the energy requirement of the animals is predominantly covered by the nitrogen-free fats. Therefore, the nitrogen-containing

The new process is based on the rolling out of formed bodies which can be produced e.g. by extrusion or pelleting, to give thin feed flakes slowly sinking in water.

Thus, energy-rich feed flakes were produced with the new process and tested on typical ornamental fish for aquaria with regard to suitability in comparison with traditional standard feeds with low fat contents: In a feeding experiment on two different ornamental fish species (*Labidochromis caeruleus*, *Barbus conchonus*), there was tested for effectiveness a flaked experimental feed with high energy content (33% fat) in comparison with a control feed (7% fat) over a period of time of 12 weeks in the case of a water temperature of 25°C.

The results clearly demonstrate that, in the case of the application of the energy-rich flake feed, the feed uptake is clearly increased and the growth of the fish is significantly better in comparison with the control. Similar results are shown in the case of the feeding of experimental flakes with 18% or 23% of fat in comparison with a test diet with 8% fat.

Therefore, having regard to these surprising new findings, the production and the use of fat-rich flaked feed is also advantageous for the maintenance of ornamental fish.

Therefore, the subject of the present invention is an energy-/fat-rich flake feed for fish and invertebrates, as well as the production and use of these flakes.

A flaked ornamental fish feed is preferred which, in homogeneous distribution, contains energy in the form of 12 - 40% fat, preferably 12 to 20% and quite especially preferably about 15 to 19% fat in the case of a moisture content of 1 to 30%, preferably 4 to 25% and quite especially preferably of about 8%. In addition, this feed

For the production of energy-rich feed flakes, there can be used, according to the methods set out in the following, all commercially available liquid and solid fats and oils of animal or vegetable origin, individually or in combination (e.g. soya oil, fish oils, marine animal fats, tallow, sunflower oil, maize oil).

In the case of the production of extrudates, the weighed out recipe components are homogeneously mixed in a mixer with the necessary amounts of energy in the form of fat/oil and extruded. Thereby, for example, first 330 kg of energy-rich raw material mixture are extruded with a barrel extruder speed of 60 - 98%, preferably 75%, and a temperature at the meal introduction region of 40 - 160°C, preferably 75°C, and in the nozzle head of 40 - 190°C, preferably 75°C, with addition of 1 - 100 l, preferably 30 l of water per hour to give 1 to 50, preferably 2 - 4 mm long extrudates with a stick diameter of 1 to 10 mm, preferably 2 - 4 mm.

Brought about by the geometry of the outlet nozzle of the extruder and of the desired section length of the extrusion billet, sections are obtained with equal three-dimensional form.

Subsequently, these extrudates are rolled out directly in a cylinder mill to give uniformly formed flakes with a thickness between 10 μm and 5 mm and a diameter between 1 to 100 mm, which also possess an equal three-dimensional form.

Formed bodies with substantially equal three-dimensional form suitable for rolling out can also be obtained by pelletisation of the fat-rich raw material mixture which can subsequently be rolled out to give uniformly formed flakes.

In the case of the production of formed bodies by means of extrusion, the temperature is reducible to $< 80^{\circ}\text{C}$.

In the case of this process, after the production no additional working steps, such as e.g. spraying or coating with oils/fats for the energy enrichment - as in the case of conventional pellets - are necessary.

A further subject of the invention is the use of the homogeneous fat-rich feed according to the invention for the promotion of growth, feed uptake and condition of ornamental fish in fresh and sea water, for the improvement of the resistance against stress, for the prevention of losses in the case of unfavourable maintenance conditions, such as high temperatures in the summer and low temperatures in the winter in the case of the maintenance of pond fish, as well as for the reduction of the nitrogen and phosphorus excretion promoting algal growth.

Homogeneous fat-rich feed in the form of feed flakes, as well as process for the production and its use for the promotion of growth, feed uptake and condition of fishes and invertebrates in fresh and sea water, for the improvement of the resistance against stress, for the prevention of losses in the case of unfavourable maintenance conditions, such as high temperatures in the summer and low temperatures in the winter, in the maintenance of pond fish, as well as for the reduction of nitrogen and phosphorus excretion promoting algal growth.